

Claims

[1] An internal combustion engine comprising:

a cylinder block having one or more cylinders;

a cylinder liner with a tubular shape, disposed inside said cylinder;

a piston reciprocating inside said cylinder liner and having a top land portion formed of an outer periphery of the piston sandwiched between a piston head and an uppermost ring groove; and

a liner installation ring forming a circular step portion inside the cylinder, and disposed in said cylinder block or said cylinder liner in such a manner that a bottom face of the liner installation ring faces to an uppermost portion of said cylinder liner, the circular step portion protruding to an inner periphery of said cylinder liner, wherein:

said liner installation ring is disposed at a position in accordance with a top end position of said top land portion when said piston reaches a top dead center; and

said liner installation ring is set to protrude from the inner periphery of said cylinder liner in an inward direction at a length of 0.05 mm or more to 0.5 mm or less.

[2] The internal combustion engine according to Claim 1, wherein:

a circular projection is formed on the bottom face of said liner installation ring along an inner peripheral end thereof; and

a groove portion is formed below said circular step portion, being sandwiched between the inner periphery of said cylinder liner and said projection.

[3] The internal combustion engine according to Claim 2, wherein:

said projection is formed in a tapered shape, inclining downwards to the inside of the cylinder from a crosspoint of the bottom face of said liner installation ring and the inner periphery of said cylinder liner; and

an angle that a tapered surface of said projection forms with the inner periphery of

said cylinder liner is in a range of 45 degrees to 60 degrees.

[4] The internal combustion engine according to Claim 1, wherein:

a circular notch is formed on an internal diameter side of a contact face of said cylinder block or said cylinder liner with said liner installation ring; and

a groove portion is formed below said circular step portion, being sandwiched between the bottom face of said liner installation ring and said notch.

[5] The internal combustion engine according to Claim 4, wherein:

said notch is formed in a tapered shape, inclining downwards from the contact face with said liner installation ring to the internal diameter side; and

an angle that the bottom face of said liner installation ring forms with a tapered surface of said notch is in a range of 45 degree to 60 degree.

[6] The internal combustion engine according to any one of Claims 1 to 5, wherein:

an external diameter of said liner installation ring is set to be larger than an external diameter of an uppermost portion of said cylinder liner; and

a latch step portion is formed in the upper portion of said cylinder of said cylinder block and latches said liner installation ring to restrain its downward movement.

[7] The internal combustion engine according to Claim 6, wherein:

the uppermost portion of said cylinder liner is positioned above the uppermost ring groove when said piston reaches the top dead center; and

the uppermost portion of said cylinder liner is disposed below said latch step portion with a distance.

[8] The internal combustion engine according to any one of Claims 1 to 7, wherein

said liner installation ring has open parts in a peripheral direction thereof which face to each other with a predetermined distance, in order to fix said liner installation ring on said cylinder block or said cylinder liner by tension of the open parts separating from each

other.

[9] The internal combustion engine according to any one of Claims 1 to 8, wherein a ring-side circular groove is formed in the inner periphery of said liner installation ring in a peripheral direction of the ring.

[10] The internal combustion engine according to any one of Claims 1 to 9, wherein a piston-side circular groove is formed in the top land portion of said piston in a peripheral direction of the piston.

[11] The internal combustion engine according to any one of Claims 1 to 8, wherein: a ring-side circular groove is formed in the inner periphery of said liner installation ring in the peripheral direction of the ring; and a piston-side circular groove is formed in the top land portion of said piston in a peripheral direction of the piston in such a position to face to said ring-side circular groove when said piston reaches the top dead center.

[12] The internal combustion engine according to any one of Claims 1 to 11, wherein: a piston-side circular groove is also formed in a second land portion in the peripheral direction of the piston, the second land portion being positioned below the top land portion of said piston and the uppermost ring groove.

[13] The internal combustion engine according to any one of Claims 9 to 12, wherein a longitudinal section of at least one of said ring-side circular groove and said piston-side circular groove is V-shaped such that a top face thereof is horizontal or upwardly inclines to a bottom of the groove, and a bottom face thereof is tapered in such a manner that it goes away from the bottom of the groove as it goes downward.

[14] A liner installation ring to be applied to an internal combustion engine that comprises a cylinder block having one or more cylinders with a latch step portion in its/their upper portion(s), and a tubular cylinder liner disposed in said cylinder; the liner installation

ring being disposed in said latch step portion with its bottom face facing to an uppermost portion of said cylinder liner; while disposed, an inner peripheral end of the ring inwardly protruding from an inner periphery of said cylinder liner to said cylinder to form a circular step portion inside said cylinder, wherein

a length from a position of the inner periphery of the cylinder liner when said liner installation ring is disposed to the inner peripheral end of the disposed ring is set to be in a range of 0.05 mm to 0.5 mm.

[15] The liner installation ring according to Claim 14, wherein:

a circular projection is provided in the bottom face along the inner peripheral end of the ring;

said projection is formed in a tapered shape such that it downwardly inclines to the inner periphery of the ring from a position of the inner periphery of the cylinder liner when the ring is disposed; and

an angle that a tapered surface of said projection forms with the inner periphery of said cylinder liner is in a range of 45 degrees to 60 degrees.

[16] The liner installation ring according to Claim 14 or 15, wherein

the liner installation ring has open parts at a position in a peripheral direction of the ring, the open parts facing to each other with a predetermined distance.

[17] The liner installation ring according to any one of Claims 14 to 16, wherein

the liner installation ring has a ring-side circular groove in the inner periphery in a peripheral direction of the ring.

[18] The liner installation ring according to Claim 17, wherein

a longitudinal section of said ring-side circular groove is V-shaped such that a top face thereof is horizontal or upwardly inclines to a bottom of the groove, and a bottom face thereof is tapered in such a manner that it goes away from the bottom of the groove as it

goes downward.